



# Plant detectives struggle against time

Above: Professor Eleonora Gabrielian and her colleagues have been steadfastly dedicated to the precious botanical collections at Armenia's Institute of Botany. Brad Collis

In a crumbling Armenian institute, priceless botanical records of crop lineages and unique floral biodiversity are being lost to the blanket of time. Australian agricultural scientists, who know the archives hold vital information about the world's food plants and their adaptability, are pitching in to safeguard what they can. **Brad Collis** reports.

Dr Izabella Arevshatian carefully folds a new plant specimen inside the pages of an old Soviet newspaper; the photograph of a heroic astronaut fleetingly exposed before the page is creased and flattened against the fresh green leaves. It's her collection-mission ritual, repeated twice a day to start the drying and pressing of plants for archiving in Armenia's Institute of Botany.

The Institute houses more than 150 000 specimen sheets, diligently compiled by generations of botanists. It forms a globally significant archive of plant biodiversity, especially of food crops – and it is in serious trouble. The yellowing pages of propagandised space-age triumph now wrap the last vestiges of a time when Soviet botanists and plant breeders also held the world stage.

Dr Arevshatian and her colleagues have had almost no source of official support since the collapse of the Soviet Union. Their Armenian government salaries are US\$24 a month, from which they not only have to feed and clothe themselves, but also keep the Institute running.

'It's like it was in the war ... no water or electricity, but we saved the collection ... and that's what we are doing again,' says Dr Arevshatian.

But that was almost 60 years ago when they were robust young students. Dr Arevshatian and her colleagues, Professor Eleonora Gabrielian, the Institute's Director, and Dr Estella Nazarora, are now elderly women. The determination that has kept them and their work alive through freezing winters and the crushing sense of apathy from outside can't last.

Yet they are driven, still, by the vision of the Institute's founder Alexander Shelkovnikov and their student-days mentor, Professor Armen Takhtajian. These are famous names in international botany, but their once-glorious institute is now a worn-out building disappearing into an abandoned jungle that used to be the adjoining botanic gardens. That it functions at all is due solely to the extraordinary faith being kept by this small group of former students.

'Professor Takhtajian inspired in us the beauty of plants,' says Dr Arevshatian simply.

The inside is spartan and dusty, rooms overflowing with head-high piles of pressed plant specimens, brittle inside the pages of newspapers dating back to Stalin's regime. There is not a single computer. The records of generations of scientists remain on paper cards in

## The determination that has kept them and their work alive through freezing winters and the crushing sense of apathy from outside can't last.

wooden filing cabinets. It is a treasure-trove of fragile, rare, botanical history.

'I am optimistic,' says Dr Arevshatian, 'because we have come through hard times before. Sometimes politics tries to ignore, or destroy, science. But science always wins because science serves the people.'

In her upstairs office, Professor Gabrielian proudly displays a colour photograph of a rare flower, *Ornithogalum gabrielianae*, a new species discovered on Mount Aragatz, Armenia, in 1997 and named after her – the eleventh plant species to be named in her honour.

Professor Gabrielian is renowned in world botany, yet she sits in a small room stacked high with fading hope and memories, surrounded by her lifelong collection and the 11 weighty monographs she has authored and published. It is a priceless repository but has no clear future or home when she and her septuagenarian colleagues can no longer work.

She opens her arms indicating the piles of newspapers that hide tens of thousands of dried, pressed specimens. 'Some of the most beautiful and rare wild plants on the planet are here,' she says. 'And like all plants they hold crucial places in delicately balanced ecosystems. Some of these plants come from landscapes that swing from plus 40 to minus 40 degrees Celsius between summer and winter. It is vitally important to find out what plants like this can teach us.'

Eleonora Gabrielian has been collecting since she was a student in 1946. That same year she met her husband, who then worked alongside her for the next four decades. He died in 1994, after a bitter winter when there was no heating at all.

'Perhaps we are crazy,' says Professor Gabrielian solemnly. 'We are paid 74 000 drams [US\$24] a month and we each have to put in 20 000 drams for electricity. But botany is our life. It is the science of life and it keeps us going. Future generations will need this knowledge if they are to sustain the planet's biodiversity ... but I am 76 years old and I need to be able to put what's in my head into the heads of future generations.'

The lament is heartfelt, and for younger scientists like Australian agricultural ecologist Dr Ken Street, who has been leading recent international efforts to try to save the region's vital genetic resources, it is a critical, global, issue. 'Ten years from now we will be facing the prospect of this region having no trained agricultural scientists in germplasm conservation,' he says.

'This is frightening, because the genetic origins for a very large proportion of the world's food crops, including the crops we grow in Australia, do not exist anywhere else.'

'What's even more frustrating is it would only take about A\$20 000 to get the Institute back on its feet and safeguard its collections,' he says.

Dr Street, who is based at the International Centre for Agricultural Research in Dry Areas (ICARDA) in



Syria, has been managing germplasm preservation projects in the Caucasus and Central Asia for several years.

The projects, funded by the Australian Centre for International Agricultural Research (ACIAR), have been seeking to preserve the genes of ancient crop races or wild progenitors for use by modern plant breeders faced with keeping agriculture abreast of changing environmental conditions.

In recent years Dr Street has undertaken a number of collection missions to capture as much genetic variation as possible in the plant species that are important to world agriculture.

His most recent mission in Armenia was in collaboration with Dr Arevshatian, Dr Tamara Smekalova, head of Agrobotany at the Vavilov Institute in St Petersburg, and Dr Clive Francis from the Centre for Legumes in Mediterranean Agriculture (CLIMA) in Perth.

Australian support for the work stems from the fact that Australian farmers are as desperate as any for crops that can withstand the tightening grip of droughts, frosts, saline soils, fungal diseases such as rust, and the spectre of global warming.

While a two- or three-degree increase in average temperatures may be perceived by people as merely a comfort issue, the chilling fact not widely appreciated is that a fraction-of-a-degree change can be enough to stop many food plants from flowering and delivering grains and fruits – our food.

**Dr Ken Street collects local grains from Armenian villagers.** Brad Collis



**Armenia's once thriving Institute of Botany is now barely running on the equivalent of a few dollars per day.** Brad Collis



**Australia's Dr Clive Francis is aware that the Caucasus region represents the birthplace of many of today's staple crops.** Brad Collis

Added to this, modern crops have been pampered by aeons of farming and breeding for higher and higher yields, or for traits like whiter bread dough. Consequently a lot of the 'toughness' of earlier crop types has been whittled back as the genetic base has narrowed.

So it's those genes that allow the old relatives of modern crops to still flourish in frozen or arid landscapes that need to be found and reintroduced.

'We are going back through time, backwards through man-made evolution,' explains Dr Street.

'We are looking for the grasses that were used for bread-making thousands of years ago – at the start of civilisation when people first saw that keeping and sowing seeds from the best plants gradually improved what they were harvesting.

'We are searching for what our far distant ancestors were using, not because they are better but because they have a wider genetic base. A modern wheat plant might have a few hundred parents, but the ancient varieties had hundreds of thousands, perhaps millions, of parents.'

The genetic diversity of the Caucasus, and the lure of discovery, is also what keeps pulling Dr Clive Francis back to the region, long after he had intended retiring.

'This area is the birthplace of wheat, numerous fruits, vegetables like onions, and a lot of the world's legumes ... not to mention scores of flowering plants such as tulips and gladioli,' he says.

Gazing across a meadow brimming with plant life, a wind-ruffled soup of botanic diversity, Dr Francis explains that there are 125 species of *Astragalus* alone in Armenia. *Astragalus* is part of the legume family – what most people know as peas, beans or lentils. Legumes are his passion and Armenia is Xanadu, a paradise of agricultural opportunity.

'The legumes we grow in Australia are annuals, but there are perennials here ... crop plants that could help us manage our wheatbelt water table and limit the build-up of salinity,' he says.

'And a lot of these legumes are readily usable by plant breeders.'

However, he says the old wheats are a longer-term proposition. 'We only want specific genes, like the drought or frost-tolerance genes. We don't want genes that might undo the highly developed agronomic traits of modern varieties. But this is difficult to control using normal cross-pollination techniques, and in Australia we're not allowed to use gene transfer technologies in food crops.'

Collecting missions like these, in countries such as Armenia, are now part of an international program developed under the auspices of the new Global Crop

## Australia backs the Global Crop Diversity Trust

International efforts to conserve the global plant gene pool, particularly of plants from which food crops originate, is moving up a gear through the recent creation of the Global Crop Diversity Trust.

Australia is the biggest donor (more than \$20 million) to the new international organisation established to protect the genetic diversity that allows crops to adapt to environmental changes.

The Trust's Rome-based Executive Director, Dr Cary Fowler – one of the instigators of the proposed 'doomsday vault' gene bank in the Arctic Circle – was recently in Australia to explain why crop diversity needs urgent and 'painstaking' conservation.

He reminds us that the planet's plant gene pool represents all the genetic options a crop has, so any erosion of this resource could prove fatal for some crops if, for example,

the ancestral genes they need to adapt to pressures like global warming are the ones lost.

Dr Fowler says there are about 6.5 million plant samples (or 'accessions') stored in 1500 collections worldwide, and until the establishment of the Trust there was no provision for sustained financial support for these collections, which are vulnerable to dangers as simple as a generator failure or as misguided as budget cuts.

He adds that without ongoing breeding, many modern cultivars have a limited life expectancy. 'For example, if we left maize alone, the crop would be gone in about 10 years. And wheat is essentially a human artefact. If we repeated the breeding that created wheat, it would be considered a GMO (genetically modified organism). Maintaining these crops therefore requires access to wild relatives and other sources of

novel genetic material.'

Dr Fowler says Australia, whose agriculture is based entirely on introduced species, is particularly vulnerable. This is why the Australian Government, through the Grains Research and Development Corporation, was quick to support the Trust.



**Local legumes from the Caucasus region.** Brad Collis

**More information:**  
[www.croptrust.org/items/homepage.php](http://www.croptrust.org/items/homepage.php)



Clockwise from left: Dr Izabella Arevshatyan (right) and a colleague work on the classification of a few of the Institute's genetic treasure trove of dried specimens. Dr Ken Street knows there are clues in both the local plants and the Institute's archives as to how Australia's crops might be helped to adapt to climate change. Dr Clive Francis and Professor Eleonora Gabrielian are working together to safeguard the Institute's archives while time allows. Brad Collis



Diversity Trust, set up as an instrument of the International Treaty on Plant Genetic Resources for Food and Agriculture.

'It's a survival issue,' says Dr Street.

'For most people around the world that means avoiding starvation, while for farmers in countries like Australia it's economic survival. For example, late-season frosts destroy millions of dollars worth of cereal crops in Australia every year. This is because the genetic origin of Australian varieties mirrors our political and cultural origins – Western Europe – which is not the ideal genetic lineage for the Australian environment. By comparison, there are wheat varieties in Central Asia and the Caucasus that comfortably tolerate frost and low rainfall. These varieties need to be re-identified, catalogued and made available to Australian plant breeders.'

Dr Street concedes that there is a frustrating element of the abstract in the goal because these 'horrible old weeds' are too far removed from their modern descendants to be able to be crossed by conventional breeding. It is possible using gene modification (GM) technology which can precisely locate and reincorporate specific genes, but politics has, for the moment, put the technology beyond the reach of Australian food-crop scientists.

The work by Drs Street and Francis also involves trying to save, or rebuild, the once pre-eminent plant collections housed in the crumbling, neglected, botanical institutes of the former Soviet republics in Central Asia and the Caucasus.

'The world is losing irreplaceable seed from these collections simply because the local people can't afford to replace water pumps, or stored seed is being eaten by mice. This is an absolute tragedy; doubly so because it is avoidable,' says Dr Street.

'The rate of deterioration is very advanced so we are desperately trying to collect, store, document and manage as much diversity from old varieties and wild relatives before they are gone forever. We don't know what challenges future farmers will face, but we do know the answers to those challenges are held in the genes of the plants we are collecting.'

Enquiries about assisting the Institute may be directed via *Ecos* at [ecos@csiro.au](mailto:ecos@csiro.au).

**Contact:**

Ms Natalya Rukhkyan  
Institute of Botany Armenia  
64, Avan, Yerevan, 375063, The Republic of Armenia  
Tel: +(374 1) 61 4241; apt. +(374 1) 56 4658  
Emails: [n.rukhkyan@cac-biodiversity.org](mailto:n.rukhkyan@cac-biodiversity.org); [nati@netsys.am](mailto:nati@netsys.am)  
Dr Ken Street, ICARDA, [k.street@cgiar.org](mailto:k.street@cgiar.org)

**More information:**

ICARDA: [www.icarda.org](http://www.icarda.org)  
Plant genetic resources in Central Asia and Caucasus:  
[www.cac-biodiversity.org](http://www.cac-biodiversity.org)  
ACIAR: [www.aciar.gov.au](http://www.aciar.gov.au)